Speed and the Fog of War: Sense and Respond Logistics in Operation Iraqi Freedom-I

Case Studies in National Security Transformation
Number 15
Paul Needham and Christopher Snyder
January 2009

Sponsored by the Office of the Deputy Assistant Secretary of Defense
Forces Transformation and Resources

Prepared by the Center for Technology and National Security Policy

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
JAN 2009		**00-00-2009 to 00-00-2009**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Speed and the Fog of War: Sense and Respond Logistics in Operation Iraqi Freedom-I	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **National Defense University,Center for Technology and National Security Policy,300 5th Avenue SW,Washington,DC,20319**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**20**	

The views expressed in this article are those of the author and do not reflect the official policy or position of the National Defense University, the Department of Defense, or the U.S. Government. All information and sources for this paper were drawn from unclassified materials.

Dr. Paul Needham is professor of logistics and Director of the Supply Chain Management Concentration Program at the Industrial College of the Armed Forces. He is retired from the United States Air Force after serving 23 years in various logistics positions.

LtCol Christopher Snyder is a logistics officer in the Marine Corps. He was assigned to the 1st Marine Division, G-4, as an Individual Augmentee (IA) during Operation *Iraqi Freedom* (OIF)-I. He has served in various staff positions and has commanded the 3rd Transportation Support Battalion, III Marine Logistics Group, and later the Logistics Operations School, Training Command. LtCol Snyder is a 2008 graduate of ICAF.

Introduction

The term "fog of war" is often associated with the commander's lack of clear information on the battlefield. "War is inherently volatile, uncertain, complex, and ambiguous. For this condition, contemporary U.S. military usage offers the acronym VUCA."[1] Compounding the "fog of war" on the modern battlefield is the high tempo of operations or speed sought by commanders to overwhelm and defeat the enemy. This case study proposes that the use of sense and respond (S&R) logistics during Operation *Iraqi Freedom* (OIF-I) would have provided logisticians critical decisionmaking information (situational awareness) thereby reducing the fog of war and facilitating more efficient and responsive support to the warfighter. In drawing this conclusion, the following study analyzes the events of OIF-I, citing logistical lessons learned and difficulties experienced, and offers suggestions to reduce those challenges.

The implementation of S&R logistics will shape future joint logistics requirements while driving changes in joint doctrine and how we support the operational environment. Current efforts under the Forces Transformation and Resources Office (formerly the Office of Force Transformation) and the Program Manager, Light Armored Vehicle (PM-LAV) pave a path for S & R logistics implementation within the military. Lastly, the study highlights the current Marine Corps logistics operations in Iraq and offers some insight into the future. An initial overview examines the events that led to the overthrow of Saddam Hussein.

OIF-I: An Overview

By most accounts the invasion of Iraq, now known as Operation *Iraqi Freedom-I*, was a huge success. During March 2003, 167 ships operated by the Military Sealift Command created a "Steel Bridge of Democracy" that ferried required equipment forward into theater. To appreciate the range of this endeavor, there was on average a ship every 72 miles from the United States to Kuwait.[2] Additionally, pilots flew thousands of C-130, C-5, and C-17, and commercial sorties both inter- and intratheater to deploy and position almost 424,000 U.S. personnel and their equipment.[3] This herculean feat facilitated the reception, staging, onward movement, and integration (RSO&I) of forces in the Area of Operations (AOR) and supported the concept of operations developed by the combatant commander.

Subsequently, "during OIF, we witnessed the most dominating, rapidly moving, and ultimately successful combined air, sea, and ground fighting force ever to go into battle. The battle plan called for a 30-day campaign to combat victory. The coalition did it in 3 weeks."[4] Common conventional military doctrine would have dispatched a few hundred thousand troops on the move to Iraq supported by a large logistics tail known as the "iron

---

[1] Eugenia C. Kiesling, "On War: Without the Fog," *Military Review*, Sept.–Oct. 2001, 1.
[2] Globalsecurity.org, "Sealift in Operation Iraqi Freedom," Globalsecurity.org, available at <http://www.globalsecurity.org/military/systems/ship/sealift-oif.htm>.
[3] T. Michael Moseley, *Operation Iraqi Freedom: By the Numbers* (Tampa, FL: Assessment and Analysis Division, USCENTAF, 2003), available at <http://www.globalsecurity.org/military/library/report/2003/uscentaf_oif_report_30apr2003.pdf>.
[4] Christopher M. Kennedy et al, *U.S. Marines in Iraq, 2003: Anthology and Annotated Bibliography* (Washington, DC: History Division, United States Marine Corps, 2006), 1.

mountain." Instead, then Central Command Combatant Commander, General Tommy R. Franks, "envisioned a swarming, rapid, responsive force capable of removing threats immediately: relying on speed more than mass."[5] The concept of speed became the underlying theme throughout the war for all commanders, and in particular for the 1st Marine Division, "speed was a culture."[6]

Based on the timely accomplishment of military objectives, one would envision that OIF-I was a model for success. However, there were fundamental challenges in providing logistics support across the battlefield to support both a high tempo and aggressive operational pace. The 350-mile move in figure 1 from Kuwait to Baghdad utilized a supply system more suited to the Cold War environment based upon the requisition methods, delivery means, and time delays. The VUCA environment also highlights the need for an agile combat force supported by logisticians who can quickly adapt and sustain the warfighter with all required resources.

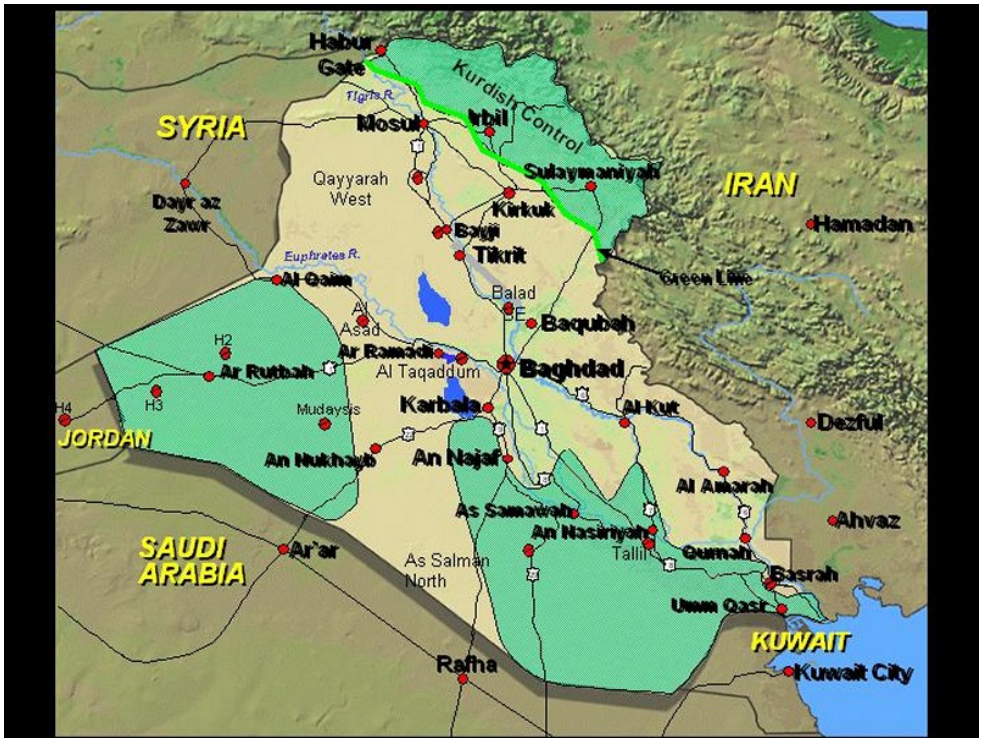

Figure 1: Map of the Battlespace[7]

Although all services made significant logistical achievements, this case study will largely focus on the Marine Corps. OIF-I involved unprecedented movements for the Marine Corps.

> During the successful execution of Operation *Iraqi Freedom*, the 1st Marine Division (1stMARDIV) conducted the longest sequence of coordinated overland

[5] Diane K. Morales and Steve Geary, "Speed Kills: Supply Chain Lessons from the War in Iraq," *Harvard Business Review* 81, no. 11, November 2003, 16.
[6] Christopher M. Kennedy et al, *U.S. Marines in Iraq, 2003: Anthology and Annotated Bibliography* (Washington, DC: History Division, United States Marine Corps, 2006), 62.
[7] Globalsecurity.org, *March 28, 2003 DoD Briefing* (Washington, DC: Department of Defense, 2003), 1, available at <http://www.globalsecurity.org/military/ops/iraqi_freedom-ops-maps_03-2003.htm>.

> attacks in Marine Corps history. From crossing the line of departure (LOD) on the border between Kuwait and Iraq, to the culmination of hostilities well north of Baghdad, the division covered 808 kilometers in 17 days of sustained combat.[8]

Understanding the complex coordination and sequencing to move the force is highlighted by this statistic from March 23, 2003:

> The division began crossing the Euphrates River in the vicinity of An Nasiriyah using bridges to the east and west of the city. Within 12 hours, the division passed 8,000 vehicles through this vital choke point and was then poised for operational maneuver on Baghdad.[9]

"Supporting a rapid speed of advance became the metric that guided all the division G-4's (logistics officers') preparation for combat."[10] Planning was instrumental, especially with fuel considerations. Initially, a methodical analysis was conducted to determine culminating points for the main maneuver units, Regimental Combat Teams (RCT) 1, 5, and 7. The analysis was based on standard planning figures found in doctrinal publications, and the experience of senior logisticians. Retrospectively, the figures were optimistic and too conservative. Combat loads, desert terrain, and 24-hour operation of vehicles consumed more fuel than even the most robust estimates.

The combat service support battalion responsible for the division's success was CSSB-10, supplied from the 1st Force Service Support Group (FSSG). CSSB-10 provided direct support to all 1stMARDIV units in the I Marine Expeditionary Force (MEF) zone.

> During the combat phase of the operation, the battalion conducted over 400 such convoys, covering nearly 120,000 miles, in order to sustain the forward movement of the 1st Marine Division in its attack towards Baghdad. The battalion distributed nearly 3,000 pallets of Meals Ready to Eat (MRE's), nearly 1,000,000 gallons of water, over 2,000,000 gallons of fuel, and over 2,000 tons of ammunition.[11]

Even during this prodigious accomplishment, the response to demands from the division often met with time lags. Frequently, these were the result of a rapidly changing battlefield and the fog of war. For example, refueling thousands of vehicles often took far longer than expected. As the war progressed, pumps, refueling trucks, and other essential equipment began to fail, which further compounded resupply efforts. One particular challenge was the clarity of actual fuel levels. The levels were sometimes exaggerated or lacking in accuracy due to faulty fuel gauges. An added barrier concerned knowing the exact location of supported units as requests for resupply were passed and consolidated up the chain of command. Another impediment to speed and logistics responses: often units had to move before a resupply convoy could meet them. This resulted in confusion for the CSSB Marines, who did not have the same communication assets as the Division Marines and hampered a coordinated linkup. This was not a problem unique to the Marine Corps. Brigadier General Stultz (USA), Deputy Commander of the 377th Transportation Command, echoed similar challenges of keeping up with the warfighter.

---

[8] Christopher M. Kennedy et al, *U.S. Marines in Iraq, 2003: Anthology and Annotated Bibliography* (Washington, DC: History Division, United States Marine Corps, 2006), 1
[9] Ibid., 2.
[10] Ibid., 65.
[11] Ibid., 7.

"It was not so much being able to supply them, but to locate where they were moving to. That tended to be a challenge for us as we moved out convoys across the desert."[12] Further compounding the Marine Corps efforts were changes in the division's priority of effort and scheme of maneuver for the regimental combat teams (RCT's) during the movement to Baghdad.

Once again, the Marine Corps task organization proved to be a force multiplier.

> Operation IRAQI FREEDOM provided an opportunity for I Marine Expeditionary Force and the 1st Marine Division to again demonstrate the strength and flexibility of the Marine air-ground team in many areas, including logistics. The unprecedented distances over which the 1stMARDIV fought, and the speed with which it traveled, placed a considerable burden on logistics and fostered several innovative changes to doctrinal concepts of support. From early planning efforts, the division scheme of maneuver was based on the concept that speed equals success.[13]

Supporting the division's plan required a change in mindset for the logisticians and creative thinking. Moving large quantities of all supplies was not feasible, and logisticians were challenged to provide focused, precise support at the right time and location.

> Aside from organizational changes, the division logistician's also enabled speed with several planning and equipment innovations. For instance, G-4 plans developed metrics to measure a unit's tactical objectives against potential logistics culminating points and determine the optimal locations for resupply points. This enhanced the generic "days of supply" planning factors from doctrinal publications. The culminating point analysis graphically depicted where the division would require an operational pause to refuel and helped determine material and functional solutions to push off the pause.[14]

However, to say that logistics went off without a hitch would be a distortion of the truth.[15] The supply support system was one area in particular that failed to respond to the demands of supported units. As the Marine Corps came together on the battlefield, the lack of a unified Marine Corps supply system caused chaos in the supply chain. I MEF was utilizing the Asset Tracking Logistics and Supply System (ATLASS I), II MEF was using ATLASS II, and Blount Island Command was employing a commercial supply system for maritime prepositioning forces equipment.[16] Additionally, the Marine Logistics Command's (MLC) field warehouse system was scrapped at the beginning of the operation because of its inability to perform. As a result, the supply system architecture used during OIF was a combination of workarounds between systems and methods. Supply personnel from the battalion to the division level never had visibility of

---

[12] Army Logistician, "Logistics System Strained but Succeeds in Operation Iraqi Freedom," *Army Logistician* 35, no. 5, Sep/Oct 2003, 1.
[13] Christopher M. Kennedy et al, *U.S. Marines in Iraq, 2003: Anthology and Annotated Bibliography* (Washington, DC: History Division, United States Marine Corps, 2006), 65.
[14] Ibid., 66.
[15] Robert E. Love, "Operation Iraqi Freedom - Marine Corps Logistics at its Best?" *Marine Corps Gazette* 88, no. 1, January 2004, 48.
[16] Christopher M. Kennedy et al, *U.S. Marines in Iraq, 2003: Anthology and Annotated Bibliography* (Washington, DC: History Division, United States Marine Corps, 2006), 66–67.

a requisition from the time it entered the system until receipt. The system compatibility issues combined with the lack of a local area network left division's supply officers without an automated means to pass requisitions, get feedback, or reconcile management reports. Lastly, none of these systems provide any in-transit visibility in the supply chain. Although many convoys were launched throughout the operation, their contents and locations remained a mystery to those requiring the supplies. The result was a loss of faith in the system and frantic efforts to obtain parts by any means possible.[17]

Understandably, simple tasks are difficult during combat operations, but problems persisted even after hostilities came to an end. Following the push to Baghdad, the 1stMARDIV consolidated near Ad Diwaniyah. Due to seasonal rising temperatures, water needed to be cooled in M-149 Water Bulls. A request was forwarded to the Division Rear at Camp Commando, Kuwait, and all available water chillers were pushed forward. While not a combat essential item, the chillers were important to quality of life and ensuring that Marines stayed hydrated. Days passed and units began to question the status of the request. Division Rear stated the chillers had been placed on a resupply convoy and should have arrived. Division G-4 watch officers spent days trying to locate the whereabouts of the chillers by contacting all regimental logistics sections and combat service support units. Tension increased, as the simple request remained unfilled. The chillers were finally located in an obscure location. A reliable tracking method on the equipment could have avoided days of confusion and a waste of manpower. Unfortunately, this kind of experience was common. Often a Marine escort was sent with needed supplies ensuring they did not get lost along the way from Kuwait to the unit in Iraq.

In another situation following the consolidation, 1stMARDIV's Task Force Tripoli was tasked to conduct a significant movement down to the border between Saudi Arabia and Iraq. The task organization was centered on elements of three battalions of Light Armored Vehicles (LAVs). Due to the rough terrain and wear on LAV tires, the logistics plan called for a Class IX block of at least 20 spares. Initial reports indicated few if any tires in the supply system. Again, the division logistics planners and combat service support personnel began a quest to locate all available spares. Inventory counts and locations were inaccurate as the mission approached. Eventually, logisticians adequately supported the movement by locating tires in often surprising locations. Again, mission success was achieved not through any automated means, but rather through putting "eyes on" the logistics support areas to find the required items.

One final example of sustaining the warfighter centered on artillery rounds. During the initial fighting in southern Iraq, artillery units operated and were heavily supplied with Dual Purpose Improved Conventional Munitions (DPICM) 155 mm rounds. Although extremely effective in open areas against ground troops, the DPICM has a significant submunition dud rate. As the 1stMARDIV approached the populated areas around Baghdad, the 11th Marine Regiment switched to firing High Explosive (HE) 155 rounds that are more effective in urban warfare. The logisticians did not anticipate the impact of the changeover and the number of fire missions that were being executed. The resulting requests for immediate resupply of HE rounds created significant challenges to move a

[17] Ibid., 66–67.

few thousand artillery rounds from logistics support areas in Kuwait to front line units. Although the requests were eventually filled utilizing intra-theater C-130 aircraft combined with ground transport, the lack of situational awareness and information flow threatened to delay the tempo on the battlefield and the fire support to units securing Baghdad.

Push VS. Pull Logistics

After devoting a great amount of time to planning, the division's logisticians would have preferred a push-based demand chain to better meet combat unit requirements. Nevertheless, the reality of a dynamic environment, where the enemy has a say in the action, often forces logisticians into a pull-based supply chain scenario. While the pull-based supply chain is more appropriate to higher demand uncertainty,[18] the ability to respond in a timely manner is extremely difficult in a wartime environment and compounded even more by the distances and lack of information flow across the battlefield. Anticipating requirements and pushing out unneeded supplies or the wrong equipment simply slows down the tempo and conflicts with the commander's intent. Thus, because the push-pull boundary is floating, the logistician is caught in a quandary where neither supply chain option is optimal.

Ultimately, success for the Marines reflected what Major General Mattis (USMC) called a "logistics light diet."[19] While the above examples focus mainly on the Marine Corps, there are parallels within the Army 3rd Infantry Division (3rdID). One brief from the 3rdID stated, "logistics is the most challenging operation conducted on the battlefield," and "just-in-time logistics is not sufficient to support the tip of the spear."[20] Efforts for the 3rdID logisticians were exasperated by the late arrival and integration of logistics headquarters units, such as the 3rd Corps Support Command (COSCOM) just prior to the launch of the combat phase of operations. In fact, because logistics activities were not fully planned and integrated, the 3rdID made its last Class IX supply draw prior to March 19, 2003, and did not receive any replacement parts replenishment until March 30, 2003—and that draw was and inadequate to support the division's high-tempo operations.[21] The experiences of 3rdID further highlight problems associated with pull-based supply chain theory because there were few or no requisitions submitted by units for almost three weeks (see figure 2). Whether this was a case of the warfighter not requesting parts or a failure of the logistics system is a point of contention.

[18] David Simchi-Levi, P. Kaminsky and E. Simchi-Levi, *Designing & Managing the Supply Chain*, 2nd ed. (New York, NY: McGraw-Hill Irwin, 2003), 123.
[19] Science Applications International Corporation, *Objective Assessment of Logistics Operation in Iraqi Freedom* (Washington, D.C.: SAIC, 2004).
[20] Ibid.
[21] Ibid.

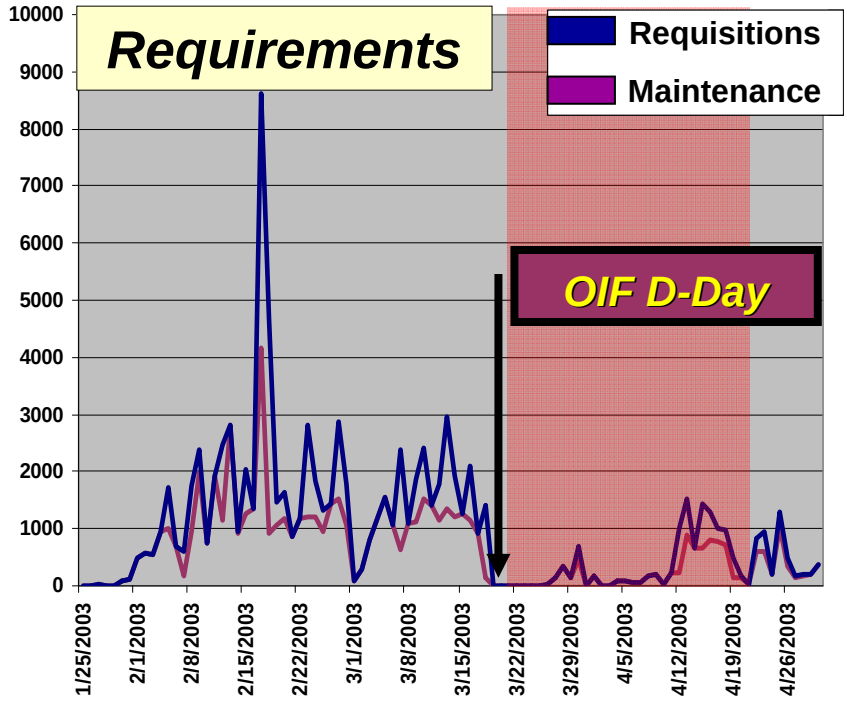

Figure 2: 3rdID Supply Requisitions[22]

Based on the well-publicized march into Bagdad, one would correctly surmise that the Army and Marine Corps ultimately achieved success during OIF. However, the advance was logistically cumbersome, and the system did not necessarily perform as advertised. Nevertheless, success is often judged by where you sit on the battlefield. Accordingly, there were various opinions from the strategic to tactical level on how well the joint logistics system supported the warfighter.

Expert Critiques and Assessments

Joint Doctrine

In analyzing OIF-I, how do we define effective logistics support on the battlefield? "The supported Joint Force Commander (JFC) expects logistics to give him freedom of action—to enable the effective execution of his mission according to the timetable."[23] There are three imperatives for success in the joint logistics environment. The first is unity of effort by defining the process, establishing roles and responsibilities of the players, and identifying common output metrics while keeping the process transparent through shared awareness. "*Unity of Effort* is the coordinated application of all logistics capabilities focused on the JFC's intent, and is perhaps the most critical of all joint logistics outcomes."[24] The second imperative is rapid and precise response to effectively meet constantly changing requirements of the joint force in a complex, unfolding battle. The key characteristics of rapid response are velocity, reliability, and visibility. These features should ultimately provide an end state of improved efficiency. Essential to rapid

[22] C. V. Christianson, Our Joint Logistics Challenge, Jan 16, 2008.
[23] C. V. Christianson, "Joint Logistics: Shaping our Future," *Mobility Forum* 15, no. 3, May/Jun 2006, 24.
[24] Ibid.

and precise response is performance tracking to identify areas of success and progress while improving the overall process. Speed, is the most critical aspect of improving response and delivering critical supplies to the warfighter. On the battlefield, warfighter success is intricately tied to the speed of resupply. Lastly, joint logistics enterprise visibility must be established with an enterprise data architecture, authoritative source data, and 24/7 access to the network.[25] The use of S&R logistics can be a key enabler to accomplishing these three goals and optimizing warfighter support.

In light of the experiences of OIF, it is prudent to review Joint Publication (JP) 4.0, *Doctrine for Support of Joint Operations*. Joint Logistics is "the deliberate sharing of Service logistics resources … to support the joint force operational requirements, enhance synergy, and reduce redundancies and costs." JP 4.0 provides several principles of logistics that are a "guide for analytical thinking and prudent planning" by the combatant commander:

- Responsiveness is the "keystone" principle. Its basic premise is to provide the "right support in the right place at the right time."
- Simplicity is the "avoidance of complexity. Mission-type orders and standardized procedures . . . establishment of priorities and pre-allocation of supplies and services by the supported unit can simplify logistic support operations."
- Flexibility is the "ability to adapt logistic structures and procedures to changing situation, missions, and concepts of operation … [and] includes the concepts of alternative planning, anticipation, reserve assets, redundancy, forward support of phased logistics, and centralized control with decentralized operations."
- Economy is the "provision of support at the least cost. When prioritizing and allocating resources, the commander must continuously consider economy."
- Attainability "is the ability to provide the minimum essential supplies and services required to begin combat operations …. An operation should not begin until minimum essential levels of support are on hand."
- Sustainability is "a measure of the ability to maintain logistic support to all users throughout the theater for the duration of the operation …. Long-term support is the greatest challenge for the logistician …."
- Survivability is the capacity of the organization to prevail in the face of potential destruction. High-value targets that have a distinct effect on logistics must be protected.[26]

The use of S&R logistics is paramount to fulfilling the principles of joint logistics in the VUCA environment that characterizes current and future warfare. The battlespace will continue to evolve, and success will come through reducing the fog of war.

---

[25] Christianson, *Our Joint Logistics Challenge*, 9; Christianson, *Joint Logistics: Shaping our Future*, 23.
[26] The Joint Staff, *Joint Publication 4.0: Doctrine for Logistic Support of Joint Operations* (Washington, DC: The Joint Staff, 2000), II:1-3.

Defining Success

Without S&R logistics, how do we currently support the warfighter? According to LTG Christenson, "We do sense and respond logistics now. We just don't have the decision support tools."[27] Thus, to apply the above principles, it is incumbent upon decisionmakers to use the information available, combined with their best professional estimate of the situation. The result is an allocation of limited resources to support ongoing operations based on the plan and commander's intent. Having access to more complete and clearer information would certainly make the logistician's job easier and would help avoid costly delays.

Fundamentally, success in OIF-I was not achieved through trial and error or luck. The rapid offensive movements during OIF-I for the Army and Marine Corps were due to the lessons learned in the first Gulf War and the actions of logisticians on the ground. But at times the ability to actually track and control the moving units was nonexistent, and only accomplished based on the leadership of unit commanders. "As Brigadier General Jack C. Stultz, noted, with the combat troops of *Iraqi Freedom* moving at a faster pace than ever before, the ability of logisticians to keep them supplied was taxed but never in danger of breaking down."[28] To avoid failure, the logistician had to overcome significant hurdles to maintain the pace of the combat units. Ultimately, the stressed lines of communications unavoidably degraded warfighter support.

Other opinions of OIF-I logistics support are even more optimistic, as "support was delivered where it was required, when it was required, and the waste associated with *Desert Storm*'s "iron mountain" of unused supplies was avoided."[29] The Deputy Undersecretary of Defense for Logistics and Material Readiness goes on to say that "each combat unit was equipped with transponders, allowing both combat leaders and logisticians at Central Command to track the troops' movement in real time. Similarly, radio frequency identification (RFID) tags were attached to all inbound material containers at their point of shipment. These data, plus information from other systems, were integrated into a common operating picture, which allowed the coalition to achieve real-time information dominance."[30] Thus, at the strategic level, the accomplishments of OIF are viewed favorably. However, close examination reveals that serious challenges degraded the effectiveness of logistics support.

Another Perspective

The commanders of the 1st FSSG and MLC offer some additional insight for consideration.

> "During OIF, MEF sustainment was critical, and the volume of support provided was staggering. MLC supply fielded nearly 65 percent of over 108,000 demands, issuing over 143,000,000 pounds of ground and aviation ammunition and over 9.7 million, meals, ready-to-eat."[31]

---

[27] C. V. Christianson, Interview with LTG Christianson, January 16, 2008.
[28] Army Logistician, *Logistics System Strained but Succeeds in Operation Iraqi Freedom*, 1.
[29] Morales and Geary, *Speed Kills: Supply Chain Lessons from the War in Iraq*, 17.
[30] Ibid., 17.
[31] Christopher M. Kennedy et al, *U.S. Marines in Iraq, 2003: Anthology and Annotated Bibliography* (Washington, DC: History Division, United States Marine Corps, 2006), 162.

Although the numbers are impressive, they do not tell the whole story. According to leadership, there are significant shortfalls that must be addressed. Of particular concern is the logistics command and control capability. "We need one logistics information technology system for the entire Marine Corps and an end to Balkanization of different systems on different coasts and legacy systems that can't talk to one another."[32]

Effective sustainment involves the ability to support the requesting unit in a timely manner. Although requisitions were processed through existing supply systems, the status and location of parts was obscure.

> In-transit visibility of repair parts, both inter- and intra-theater, was not acceptable during OIF. Visibility of material was only feasible when stopped at a distribution node. The MLC could not track in-transit repair parts. It was particularly tough to indentify lost or frustrated items. We desperately need a decent logistics command and control architecture and bandwidth to support it.[33]

Furthermore, garrison logistics information technology (IT) was of little value. "In many cases the IT simply was not used, while in other cases commercial systems were used 'on the fly' in order to obtain in-transit visibility, all resulting in limited supply and maintenance discipline."[34] Given the IT issues associated with OIF, a significant investment in new and improved IT capability will be required to support future VUCA environments and capitalize on new weapons technology.

While the Marine Corps faced many challenges with in-transit visibility, perceptions at higher headquarters were at variance with reality in theater. General Walter Kross, USAF (retired), who was the Director of Operations and Logistics of the U.S. Transportation Command (USTRANSCOM), implies that *Iraqi Freedom* had "asset visibility—in transit, from factory to foxhole."[35] He goes on to say that the previous experience of Gulf War logistics with materiel not making it forward to meet a clear requirement had been fixed during OIF. In fact, at the height of the ground war, orders for Class IX repair parts virtually stopped because of the pace of the battle and difficulties with relaying requests back to supporting units. This interruption demonstrates the lack of coordination among communications systems, integration, and location. The overall fill rate was less than 55 percent, and the average order ship time was approximately 23 days.[36]

> Horror stories abound of available critical repair parts being somewhere between Kuwait aerial/seaport of debarkation and the frustrated unit in Iraq—as the supplies remained locked in the logistics chain. At the conclusion of hostilities over seventy 20-foot containers containing requisitioned repair parts were returned from Iraq to Kuwait unused and undelivered.[37]

The demand for speed and the unprecedented distances covered presented significant challenges for logistics units.

---

[32] Ibid., 162.
[33] Ibid., 162.
[34] Love, *Operation Iraqi Freedom—Marine Corps Logistics at its Best?*, 48.
[35] Walter Kross, "Iraqi Freedom: Triumph of Precision-Guided Logistics," *Army Logistician* 35, no. 5 (September-October 2003, 2003), 22.
[36] Love, *Operation Iraqi Freedom—Marine Corps Logistics at its Best?*, 49.
[37] Ibid., 49.

> Good situational awareness of the logistic status of forward deployed units is critical. For the MLC, because of the length of supply lines, the problem was not in-the-moment requirements, but what would be needed 4 to 6 days in the future. Combining experience and a clear understanding of the scheme of maneuver is critical. The current and future requirement is for predictive operational logistics to anticipate the war fighter's needs.[38]

Across the services, all units must have an ability to communicate and pass information on the battlefield. In OIF-I, Marine Corps combat support units did not possess the same command and control systems as other major subordinate commands, the division and wing. "We need the same command and control capability as any other element of the Marine air ground task force, to include position tracking and long-haul communications."[39] Without the same capability, logisticians operate in a vacuum and react to the situation rather than anticipate. The result is a force reverting to a pull-based supply chain instead of a push-based supply chain. Additionally, limited resources may be mismanaged because the dynamic environment often overcomes immediate requirements. Command and control is essential to reduce the fog of war and maintain speed. Even the best logisticians cannot support needs they do not know.

> The Marine Corps's ability to extend its logistics culminating point up to eight times the doctrinal distances is a success story for all Marines in OIF. The operational reach of the Corps is better than ever. Moreover, we can sustain the force over those distances, provided we are able to anticipate operational requirements.[40]

However, anticipation is only possible with situational awareness and the ability to alleviate confusion. "The key to future successes will be investing in the intellectual development of Marines, and the company organizations and equipment to create logistics organizations that can maintain velocity on the modern battlefield."[41] Information flow must improve for this vision to become a reality. The analysis provided by Marine Corps logisticians is important because S&R logistics provides a solution to overcome the shortfalls identified during OIF.

A Solution for the Future

Where Are We Going Wrong?

> Throughout history, smart warfighters and commanders have tried to deceive and confuse their opponents using any technological means at their disposal ….The Technologies developed to aid the warfighter in these emerging environments (fourth generation warfare) must be designed to support dynamic, adaptive operations. Sense and Respond Logistics aims to deliver precise, agile support through adaptive and responsive demand and support networks.[42]

---

[38] Christopher M. Kennedy et al, *U.S. Marines in Iraq, 2003: Anthology and Annotated Bibliography* (Washington, DC: History Division, United States Marine Corps, 2006), 162.
[39] Ibid., 162.
[40] Ibid., 163.
[41] Ibid., 163.
[42] Kshanti Greene et al, *Cognitive Agents for Sense and Respond Logistics* (Amherst, MA: Department of Science, University of Massachusetts Amherst, 2005), available at <http://www.cs.umass.edu/

In the future, military forces will operate in more complex and uncertain environments that require the application of new military concepts and technologies. Stovepiped logistics will not adequately support the warfighter in a dynamic, global environment.

In 2004, then Office of Force Transformation (now known as the Forces Transformation and Resources Office, through its charter to transform the military, embraced the concept of Network-Centric Warfare (NCW) as a core focus to enhance the operational capability of the U.S. Forces. Utilizing NCW will allow the Department of Defense (DOD) to leverage information technology and change operational reality on the battlefield. As a result, the effects-based capability of sense and respond logistics (S&RL) is being developed to apply two vital NCW ideas: avoid stovepiping, and integrate operations, intelligence, and logistics into a seamless capability.

For the Marine Corps, S&R logistics is viewed primarily as a logistics modernization effort, but the data collected is valuable not only to logisticians throughout the enterprise, but also to operators. The use of sense and respond technology will enhance logistics support. Moreover, the ability to integrate the information into operational planning and execution in real time and connect all the stakeholders throughout the enterprise will improve the survivability of the weapon systems/platforms. Thus, S&R logistics provides a solution to optimizing the supply chain, delivering enterprise-wide visibility, and establishing a life-cycle approach to systems readiness. Critical to employing S&R logistics as part of NCW is ensuring that the right people see the right information at the right time. Thus, the use of S&R logistics will not only be a force multiplier, to the logistics community, but will also increase combat readiness for the Marine warfighters.

~dcooper/papers/2005_Greene_DAMAS.pdf>.

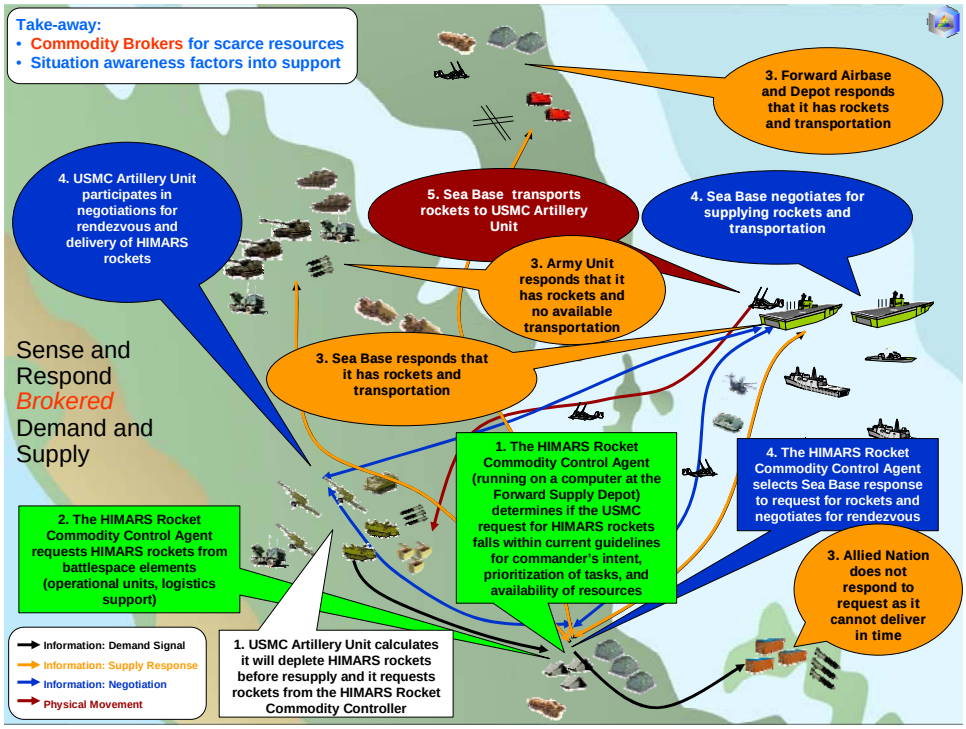

Figure 3: Notional S&R Logistics[43]

The notional illustration of S&R logistics in figure 3 presents an alternative for future logistics support. Although this scenario reflects the resupply of HIMARS rockets to a Marine Corps artillery unit, it could as well apply to resupply of 155mm HE artillery rounds during OIF-I. Is there a reason that resources cannot be reallocated or redistributed on the battlefield based on need or execution of the commander's intent? The implementation of S&R logistics will bring improvements in technology, but also requires changes in joint logistics doctrine and strategic agreements to facilitate the reallocation of resources between Services and allies.

Building on the above example, imagine the difference in the logisticians' ability to support OIF-I. With S&R logistics, fuel levels could be monitored constantly and resupply requirements could be calculated without forwarding requests over unreliable radio nets. Although CSSB-10 was able to refuel the division, the amounts delivered did not meet total requested requirement. Thus, logisticians had to allocate fuel based on their situational awareness that may have missed key information. S&R logistics provides the visibility to anticipate culminating points based on the scheme of maneuver and deliver appropriate fuel amounts to the right location and the right vehicles. Furthermore, S&R logistics enables logisticians to make decisions based on who needs limited resources based on commander's guidance/intent, and priority of effort for the battle. Finally, having a comprehensive awareness of assets on the battlefield allows the reallocation of

[43] Office of Force Transformation, *Sense and Respond Logistics: OFT S&R Overview Briefing* (Washington, DC: Office of Force Transformation, Department of Defense, 2004).

supplies, such as fuel, from one major subordinate command to another. An example is available from OIF-I. Normally responsible for refueling aircraft at Forward Arming and Refueling Points, Marine Wing Support Squadrons (MWSS), provided fuel to division units because they were closer and had fuel available. In this scenario, S&R logistics provides the total sight picture to analyze the data and make the best decisions to support the warfighter.

Current Efforts in S&R

In the Marine Corps, the concept of S&R logistics has gained significant momentum in recent years. After the U.S. Army published its Operational Requirements Document (ORD) for the Army Diagnostic Improvement Program (ADIP) dated 6 June 2000, the Marine Corps came on line with the Marine Corps Operational and Organizational (O&O) Concept for Autonomic Logistics (AL). Through the Fleet Operational Needs Statement (FONS), dated 13 March 2000, and Mission Need Statement (MNS), dated 5 April 2002, the Marine Corps identified its requirement for AL to utilize a system of communications networks to gather and transmit ground tactical equipment mission critical data to a centralized location so that it can be processed and delivered in real-time to near real-time in support of the warfighter.[44] AL would provide the capability for reporting mission critical data such as equipment health, identification, location, fuel and ammunition levels, and mobile loads in systems throughout the spectrum of Marine Air Ground Task Force operations.

At the service level, the use of S&R logistics supports the three-pronged Marine Corps Logistics Modernization (LOGMOD) improvement and integration initiative that focuses on Marine Corps people, processes, and technology. The Solution Initiating Directive (SID) states, "future Marine Corps warfighting equipment will report its operational status through Embedded Diagnostics/Embedded Prognostics (ED/EP) technologies."[45] The key "respond" portion of S&R logistics will be the fielding of the Global Combat Service Support-Marine Corps (GCSS-MC). S&R logistics is part of modernizing and integrating information technology while streamlining the supply, maintenance, and distribution processes, all resulting in a more effective and efficient Logistics Chain Management (LCM) process.

Additionally, PM-LAV, through its efforts to manage total life cycle management has established an integrated data environment (IDE) to focus on the product life cycle. Once data is collected from sensors, the IDE becomes the central depository for platform information that provides historical data and access to various stakeholders. The broad objectives of the IDE include asset management throughout the life cycle, information sharing for all stakeholders, providing access to enterprise-wide information, and leveraging existing initiatives. With the implementation of S&R, the desired end state is improved readiness and combat availability.

---

[44] Marine Corps Combat Development Command, *Marine Corps Operational and Organizational (O&O) Concept for Autonomic Logistics (AL) (NO. LOG 62)* (Quantico, VA: Marine Corps Combat Development Command, 2002).

[45] Logistics Modernization Transition Task Force, *Logistics Modernization Solution Initiating Directive* (Arlington, VA: Installation and Logistics (I&L), Headquarters, United States Marine Corps, 2005), available at <https://logmod.hqmc.usmc.mil/LOGMOD_SID_July_2005.pdf>.

Under the reliability centered maintenance (RCM) concept, the Marine Corps is moving forward with the "sense" portion of S&R logistics. "Smart" platforms under the Embedded Platform Logistics System (EPLS) are "being designed to monitor, collect, process, record, report, store, and archive the operational status and system health of the platform on which installed."[46] In September 2007, Lockheed Martin was awarded a $145 million contract for the EPLS. The EPLS is the hardware infrastructure for AL and will be installed on LAVs, Medium Tactical Vehicle Replacements (MTVRs), and Amphibious Assault Vehicles (AAVs). Utilizing data captured from individual sensors, the EPLS will provide predictive data and failure analysis consistent with RCM.[47] The result is a large amount of both operational and logistics data that can be used by the warfighter and logistician to provide predictive data prior to a mission and failure analysis for the maintainers.

The transmission of data still remains a long pole for S&R logistics. Current plans with the LAV are for the data to be passed locally via a hard connection from the LAV to a data collection system. A possible alternative is wireless transmission to a collection unit near the equipped systems, but this option raises network security concerns. In either method, the data collection process would have time delays, and logisticians needing the information would not have the visibility to be proactive and timely until the data is received.

The combination of proactive diagnostics, logistics, and prognostics seeks to change the traditional maintenance concept in the Marine Corps. Instead of conducting maintenance and inspections at fixed intervals, maintenance can take place when necessary, keeping a higher percentage of vehicles in service, saving money, and creating faster turnaround time for real problems.[48] Under the S&R logistics concept, maintenance will be scheduled and performed when failure is sensed, and parts will be ordered automatically, without human intervention. With continuous inspections through the sensors, and rebuilds taking place as required, the likelihood of catastrophic failure should be reduced. Additionally, EPLS takes the responsibility away from the crew to stop operations in hostile territory to check the readiness of a vital subsystem, e.g., LAV gearboxes. In the end, the commander should have more clarity on the readiness of equipment in the planning and execution of combat operations.

What Does the Future Hold?

While S&R technology can provide benefits in any situation/environment, the scenario presented by the rapid deployment and employment of large forces in OIF makes technology essential to obtaining clarity across the battlespace. The road ahead is challenging based upon current technology needed and funding requirements to implement S&R. Fully fielding this operational capability will not happen overnight. Although we possess the technology and tools to move forward with S&R logistics, success will only come through a directed, coordinated, and sustained joint effort. An

[46] Program Manager, Embedded Platform Logistics System, *RCM-21 Analysis of Embedded Platform Logistics System (EPLS)* (Quantico, VA: Marine Corps Systems Command, 2007).
[47] Defense Industry Daily, "USMC Putting Prognostics in its Vehicles,"Defenseindustrydaily.com, available at <http://www.defenseindustrydaily.com/usmc-putting-prognostics-in-its-vehicles-03852/?camp=newsletter&src=did&type=textlink>.
[48] Ibid.

essential question is, who will pilot this effort for DOD—a joint S&R office, or will PM-LAV continue to lead?

The potential of S&R logistics is unlimited; however, there are challenges to fully utilizing the technology. Developing an NCW environment and sharing the data throughout the enterprise will be challenging. All the players in the LCM and operational chain of commands stand to benefit from savings in scarce dollars and human lives with increased survivability. Future military operations will benefit as fewer resources are deployed, allowing a more rapid deployment and buildup of combat power. Tailored responses will be applied to both planned and unplanned events. Additionally, S&R logistics will help eliminate the iron mountain and provide more agile and flexible support. Although there is no substitute for planning, the use of S&R technology provides the logistician reliable data from sensors fed automatically. This eliminates possible transmission errors as information is forwarded via radio nets and emails, avoids inflation of the actual requirement, eliminates delays due to Marines performing other tasks, and mitigates the fatigue associated with combat. Evolution of the NCW and command and control capabilities to provide the links between transmitting and receiving signals is not instantaneous. However, the ability to transmit data across the enterprise provides logisticians with a more responsive demand and support network while allowing the operators to recognize the operational context and coordination issues to continue the mission; the end result should be savings across the spectrum and a more lethal, agile capability on the battlefield.

Current Operations In OIF – What Has Changed?

"Significant (supply) progress has been made in Iraq since OIF-I," according to BGen Kessler, Commanding General, 2d MLG, II MEF, Camp Lejeune, NC, who returned from Iraq in February 2008.[49] First, there is more confidence in the system due to intra-theater visibility. Class IX repair parts are shipped with an accompanying RFID tag that can identify all the parts in a particular box or pallet by accessing the warehouse to warfighter (W2W) system. The RFID tag identifying the parts is associated with a particular vehicle for movement from the logistics support area to the supported unit. The vehicle's movements can be tracked using Blue Force Tracker (BFT), if the resupply truck identification is known. Alternatively, visibility on shipments can also be accessed from the ITV Server that will update with the RFID tag's location each time it passes within 300 feet of an interrogator. However, there is no bridge between W2W and BFT. Currently, to gather information from both W2W and BFT, a logistician needs access to both systems to identify truck location on the battlefield and which parts are on the truck. These systems provide an improved enterprise visibility, but do not solve the problem of integrating the data architecture to enable a common logistical picture under one system.

Additionally, there is more confidence in the system due to the relatively short response time for most repair part requisitions. OIF-I experienced significant challenges because of an immature logistics theater and the high tempo of operations. Now, the environment and operating conditions are more static, and the Marine Corps' Supported Activities Supply System (SASSY) Support Unit (SMU) at Al Taqaddum, Iraq, is equal to all the SMUs in the Marine Corps, totaling approximately $124 million worth of supplies. The

[49] J. Kessler, Interview with BGen Kessler, February 22, 2008.

warehouse employs many automated features, but still relies on large containers to store inventory. Due to the large account, readiness across the MEF Forward is averaging 94-95 percent, an outstanding level even when compared to garrison operations.

Although improvements have been made on the Marine Corps side, there is still a lack of automated means to see inventory in the Army Supply Support Areas. Informal relationships exist to mutually support Army and Marine Corps units, but enterprise total asset visibility across the services is nonexistent. Until Global Combat Service Support-Marine Corps is fielded and integrated with like systems from other services, the situation will not improve. Furthermore, there are still unanswered questions with respect to the Services' Title 10 requirements to train, organize, and equip their forces, and how the issue of reimbursement will be addressed when one Service provides repair parts and supplies to another.

Conclusion

"War logistics, when truly working, should be transparent to the warfighter."[50] Based on the OFT Vision, S&R logistics is a means to this end by providing the commanders and logisticians a tool to know "what is where as well as what is on the way and when they will see it."[51] Although varying degrees of success were identified for logistics support during OIF-I, the use of S&R logistics would address many of the challenges that created so much confusion and fog during the war.

However, critical areas must still be addressed. While the EPLS is an important first step to establishing a sense capability on critical systems, the communications links and pipes to pass the sense data to the relevant decisionmakers appear to be at a standstill. The implementation of S&R logistics seems to be a sequential rather than concurrent process. Passing of the sense data across the enterprise must be given the same priority of effort and funding, otherwise data will be sensed and collected, but not acted upon. Having the capability to monitor and predict failure, knowing actual fuel and ammo levels of weapon systems, and being able to track materiel on the battlefield are all immediate needs of logisticians. Policymakers, the Armed Services, and industry, must work together to fund, develop, and field this capability. Initial efforts on the EPLS by PM-LAV will begin establishing a capability that not only benefits the logistician, but also improves the lethality of the warfighter through increased speed and confidence.

"Logistics must be ready to move and extend the logistics chain, synchronized with the advance of the combat force, to maintain continuous flow and support."[52] The challenges associated with OIF-I are not going away, and the future consists of a more VUCA environment. S&R logistics provides the capability to take the logistics community into the 21st century and revolutionize the conduct of war. The use of S&R logistics will not only enable a transformation in military logistics, but also fundamentally change the end-to-end support to the warfighter, while effectively integrating the enterprise and changing the approach to weapons systems support and joint doctrine.

---

[50] Kross, *Iraqi Freedom: Triumph of Precision-Guided Logistics*, 22.
[51] Ibid., 22.
[52] Science Applications International Corporation, *Objective Assessment of Logistics Operation in Iraqi Freedom*, 1.

Instructor's Guide to Case Study Sense and Respond Logistics

This case study proposes that the use of sense and respond logistics during Operation *Iraqi Freedom I* would have provided logisticians critical decisionmaking information (situational awareness), thereby reducing the fog of war and facilitating more efficient and responsive support to the warfighter. In drawing this conclusion, the paper analyzes the events of OIF-I, citing logistical lessons learned and difficulties experienced. The paper also offers suggestions to reduce those challenges. The case provides a good background to examine S&R logistics in the context of a major military operation.

This case study can be taught with the following objectives in mind:

Objective 1: Understand the changing support requirements to the 1st MarDiv during their movement in OIF.

Objective 2: Understand the set of challenges logisticians faced in supporting the 1st MarDiv's movement and operations.

Comment on both objectives—this case study provides numerous examples of using planning factors, and yet reality not matching the plan. Also, various low-tech sensors (fuel gauges) were not always accurate as a sensing device. The case describes numerous complications, logistics officers dealing with unknowns, and rapid changes demonstrating logistics flexibility. The case mentions fuel, water, rations, tires, and artillery rounds and provides commentary on the various problems encounters along with workarounds.

Objective 3: Understand the intent of sense and respond Logistics and how, when the concepts are applied to OIF, changes in support would have resulted.

Comment. Sense and respond logistics is based on information flows to allow for more rapid and precise logistics response. The demand signal, that is, an event that will initiate action, e.g., fuel gauge at ¼ full initiates an operation prior to push fuel forward before a vehicle runs out of fuel. S&R logistics envisions similar sensing of demand signals from all classes of supply, including Class IX repair parts—replace parts just before failure.

Objective 4: Explore how supporting future combat forces with the "sense and respond" concepts will benefit the warfighter.

Comment. S&R logistics in the future will result in greater effectiveness and increased efficiency. The set of sensors and information sharing is intended to improve situational awareness and provide the warfighter various planning options. The key to S&R is sensing the demand signal, responding rapidly to the demand signal, and sharing information creating a common operating picture. Some of the issues that will impact S&R logistics and need to be discussed are information requirements—in an austere environment without a telecommunications infrastructure, logistics information will have to be transmitted—competition for bandwidth! The demand signal must be recognized and acted on—when will the logisticians sense the demand, and how will they be able to respond?